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AMC 385-59

SAFETY DIGEST

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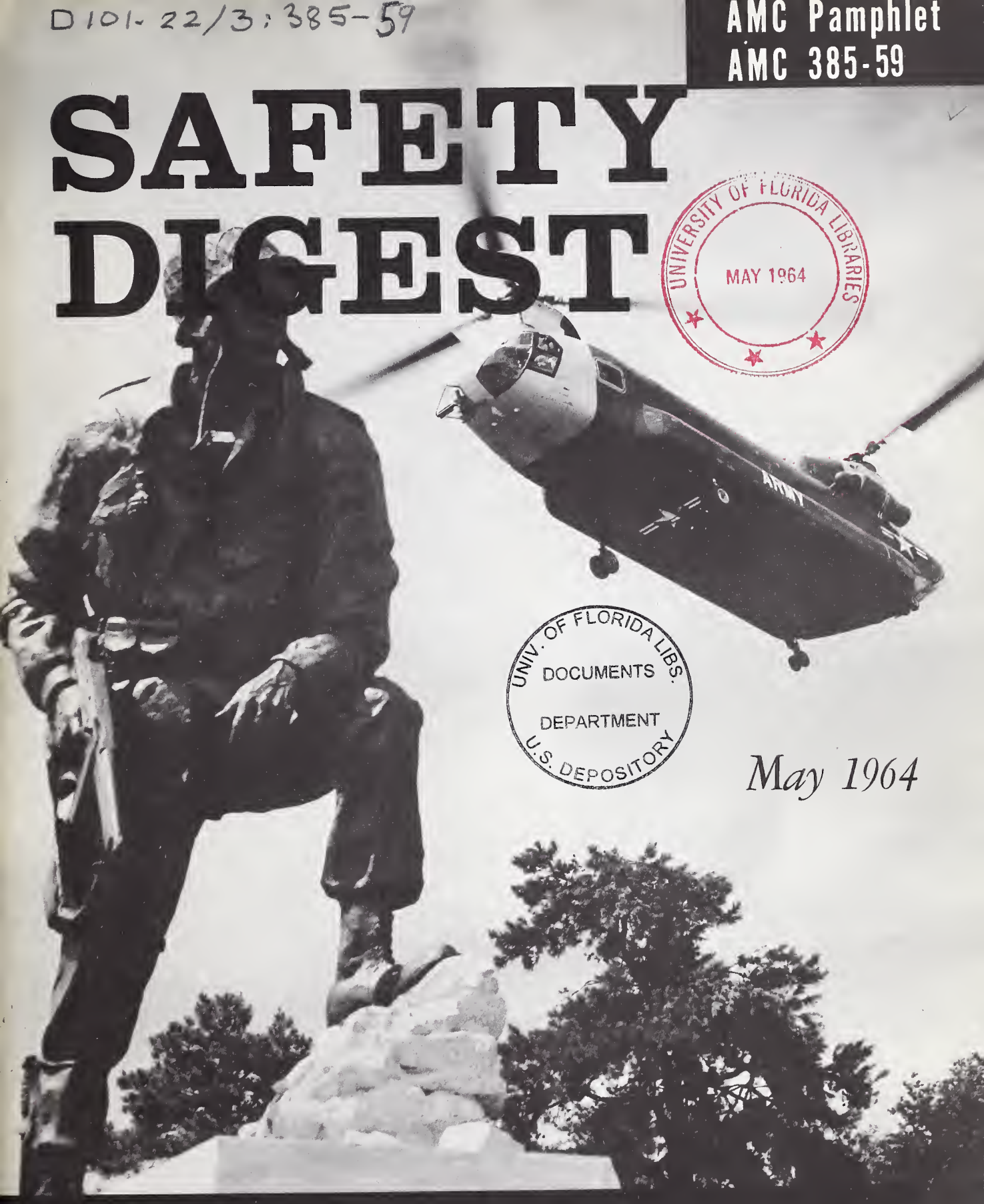

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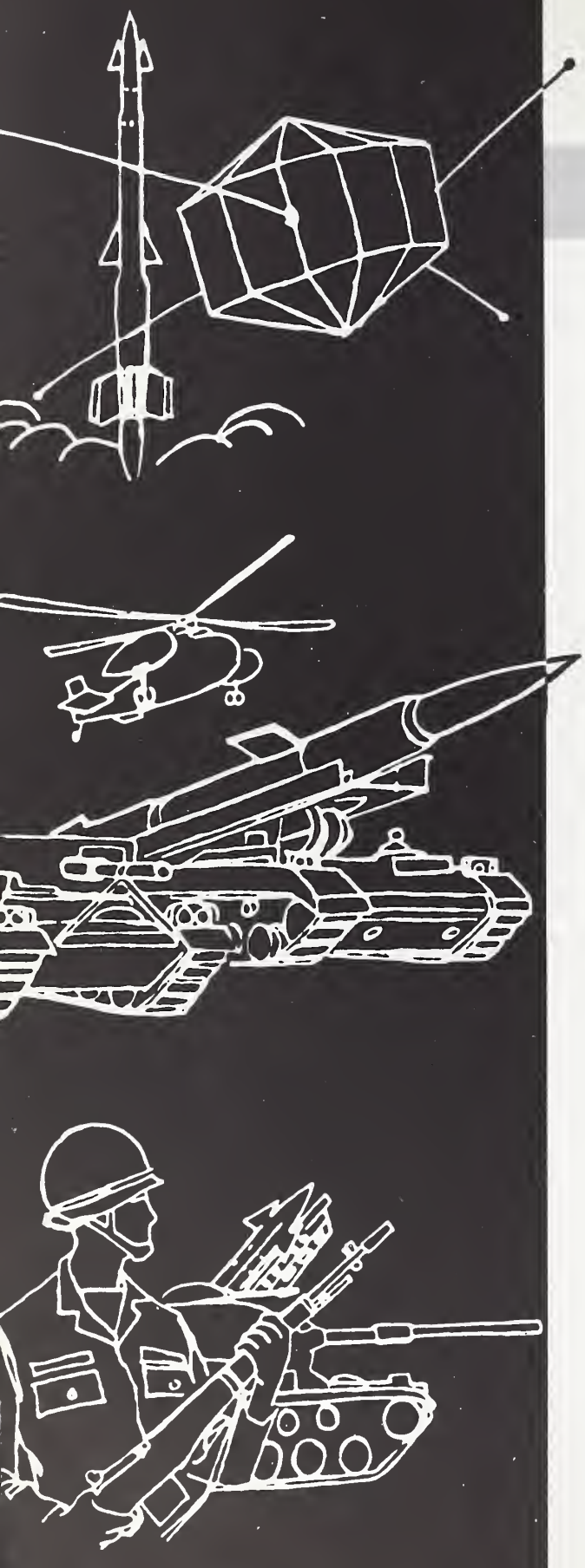

U.S. ARMY MATERIEL COMMAND

Safety Digest

FOREWORD

The Safety Digest is an AMC Pamphlet prepared by the Safety Division, U. S. Army Materiel Command. Its purpose is to disseminate information which can materially influence and improve safety programs at all Command establishments.

Articles are included to supplement technical knowledge as well as practical knowledge gained through experience. They provide a basis for the further refinement of safety measures already incorporated in operating procedures and process layout. To achieve maximum effectiveness, the Safety Digest should be given widespread circulation at each AMC establishment.

Articles appearing in the Safety Digest are unclassified and are not copyrighted. They may be reproduced as desired in order to bring pertinent accident prevention information to the attention of all employees.

Unclassified material believed to be of interest or benefit to other establishments is welcomed for publication in the Safety Digest. Please send articles for review to: U. S. Army Materiel Command Field Safety Agency, Charlestown, Indiana. If possible, include pictures, charts, drawings, and illustrations that clarify and heighten interest in your presentation.

The front cover shows the Chinook CH 47A at Ft. Benning, Georgia.

Rear cover shows the XH-51A Aerogyro with rigid rotor undergoing flight tests under joint Army-Navy funded program.

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SAFETY IN BIOLOGICAL OPERATIONS

Edward J. Lazear, Ph. D. Chief, Biological Safety Division
Pine Bluff Arsenal, Arkansas

Safety programs in biological operations must encompass the elimination of physical injury hazards and the prevention of laboratory-acquired diseases. Although it is not possible to separate the programs in actual practice, this article will deal only with the program for preventing laboratory-acquired diseases.

The hazards to be controlled are microorganisms capable of producing disease conditions varying in severity from boils to death. These microorganisms (bacteria, rickettsia, or viruses) are invisible to the naked eye and their presence in the environment is difficult or impossible to detect without expensive and specialized equipment.

An oversimplified description of a biological safety program is the organized effort to prevent the microbe from contacting the worker and supplement the worker's natural resistance so that infection cannot take place. These are not alternative programs, both approaches must be fully utilized.

Man has been endowed with a number of defense mechanisms to protect him from pathogenic microorganisms. The sum total of all of these mechanisms is referred to as resistance. Immunity is that resistance associated with so-called "antibodies" having a specific action on the microorganism which produces a particular infectious disease. Some people possess an ability to resist disease independent of antibodies. This is referred to as inherent insusceptibility. The biological program is designed to supplement and fortify the worker's defense mechanisms.

The safety program first comes into play with the selection of the employee. Each prospective employee is given a thorough medical examination to determine his present physical condition. Since the person's innate defense mechanisms may one day determine whether or not he contracts a disease, the prospective employee must be in good health at the time of employment.

The medical history of the individual is as important as his present condition. A history of some pathological conditions which may not affect present health, but could cause the body defenses to breakdown under stress is a valid reason for refusing employment. A patched tire may give years of good service for in-town driving, but its chances of blowing out at high speed on the highway are high.

In brief, only those persons are employed who are in good health and have the potential to withstand the stress of infection in the event they become exposed to pathogenic microorganisms.

After the employee has been selected, the safety program is concerned with his preparation. This involves supplementing the employee's natural defense mechanisms by a series of immunizations using weakened or killed organisms to stimulate antibody production. These antibodies will help to protect the employee if he is exposed to infectious organisms.

Having selected and prepared the employee, the safety program next is concerned with preventing the microbe from contacting the worker. This sounds like a simple task, but is in fact quite difficult to accomplish.

Barriers are placed between the operator and the organisms wherever possible. These barriers are many and varied in nature. They may be rubber gloves, stainless steel enclosures, glass windows, flowing air, ultraviolet lights, air filters, or rubber suits. If it's not possible to place barrier for an operation, a new way is found to do the operation where a barrier is possible.

None of the barriers are infallible. In the event that a barrier breaks down and a worker is exposed to an infectious organism, whether it be through a cut, by mouth or through inhalation, the worker is instructed to get medical attention immediately. Failure to report first-aid cases is punishable by dismissal.

In the event that a worker has been injured off-the-job and that injury was of such a nature that his body defense mechanism was impaired, such as an open wound, the worker is required to report to the physician who determines whether the worker should be excluded from areas of high hazard.

The program outlined above is designed to protect the worker on-the-job. In this case, individuals are working under closely controlled conditions. In order to provide some protection for individuals with whom they may come in contact outside the plant, the workers are required to bathe thoroughly before leaving the premises. This reduces the risk of a worker carrying infectious microorganisms on his person to his family, friends, and pets.

Vigorous pursuit of the program briefly outlined above has produced an excellent biological safety record at Pine Bluff Arsenal. In 8 years of working in this field only 16 clinical cases of laboratory-acquired disease have occurred. None of these cases resulted in death. In seven of the 16 clinical cases, the workers had been directly involved

in accidents which broke the physical barriers. In the remaining nine cases, the workers were unaware of any unsafe acts or barrier breakdowns which could have lead to their exposure. The fact that more than fifty per cent of the laboratory-acquired illnesses came from unknown or undetected sources emphasizes the complexity of a microbiological safety program.

DON'T MIX CHLORINE BLEACH

There have been a number of accidents resulting from mixing chlorine bleach with chemical cleaners apparently to obtain a more powerful compound. The result is definitely potent--a rather rapid release of highly toxic and irritating chlorine gas.

The best practice is to use chlorine bleach for purposes for which it is intended, i.e., bleaching and not to mix it with other compounds unless directions indicate that it is safe to do so. Chlorine is a powerful oxidizing agent which in the presence of other materials may generate much heat and has been known to cause fire. The chlorine in the bleach solution is kept under control by virtue of it being alkaline. The introduction of acidic compounds (such as bowl cleaner) upsets this balance and releases the chlorine in a hurry.

--Proceedings of the Merchant Marine Council
Construction Section, National Safety Council

SAFETY PRECAUTIONS FOR SEWAGE DISPOSAL FACILITIES

Paul K. Ward, Safety Department, Sperry Rand Corporation
Louisiana Army Ammunition Plant

On 3 September 1963, four persons engaged in the maintenance of a sewer lift station in a neighboring city were overcome with sewage gas and died. This accident resulted in the Safety and Maintenance Departments at this installation reevaluating their positions in the area of maintenance, operation, and safety precautions used in sewer lift stations and the sewage disposal plant. (Editor's Note: Each AMC installation and activity should review TM 5-665 - Operation of Sewerage and Sewage Treatment Facilities at Fixed Army Installations for DA guidance as a basis for use in developing operating procedures to its own needs.)

The primary hazards confronting employees engaged in activities around sewer systems are chlorine gas, sewage gas, mechanical hazards, and bacterial infection. To guard against these hazards, Louisiana Army Ammunition Plant has put into effect the following safety regulations:

1. Prevention of bacterial infection:

a. All employees engaged in operation or maintenance of sewage system are inoculated for typhoid and tetanus. (Editor's Note: Polio immunization should be considered, also.)

b. Employees receiving minor first-aid injuries are taken to the plant hospital immediately for treatment.

c. Employees working in the sewer lift stations are provided with clean work uniforms daily. The operator of the sewage disposal plant is provided with clean work uniforms, under-clothing and socks daily. In addition, employees are issued gloves.

d. The sewage disposal plant is equipped with shower and toilet facilities. Employees are required to shower at the end of each work shift and wash their hands thoroughly before eating.

2. Sewer gas precautions:

a. The atmosphere of sewer lift stations is tested with an explosimeter for the presence of sewer gas prior to being entered by employees.

b. Each sewer lift station is equipped with a forced-air ventilating system. The system is actuated ten minutes before personnel are allowed to enter a sewer lift station, and the forced-air system remains in operation for the entire time personnel are engaged in activities in sewer lift stations.

c. Employees entering sewer lift stations are required to wear a harness and life line. Two employees remain outside to attend the life line in the event the employee in the sewer lift should become overcome with sewer gas.

3. Chlorine Gas Precautions:

a. The use of chlorine gas in sewage treatment for disposal is required at this plant. Personnel engaged in activities that require the use of chlorine containers and gas are thoroughly oriented in the precautions listed on the Safety Factor Cards posted at each chlorine container rack and chlorinator.

b. The Safety Factors for chlorine gas read as follows:

CHLORINE IS A GREENISH-YELLOW NON-FLAMMABLE GAS

Chlorine gas is irritating to the eyes, skin and air passages. In case of LEAKS, seek fresh air immediately and call for help.

When a leak is discovered, do not attempt to shut it off until help arrives. Always keep on the windward wide of the leak. Warn other persons to stay away unless their help is needed.

In the event of leaks, only qualified personnel are authorized to shut off the leak and they must wear proper protective equipment (All Purpose Gas Mask) which is located at each chlorination station. (Editor's Note: Ref. para. 146c, TM 5-665, where chlorine gas is excessive, enter room only with a mask supplied with air from the outside).

Always keep valves closed on chlorine containers except when actually delivering chlorine to the chlorinator. Keep valve closed and cap on empty chlorine containers.

Keep chlorine containers out of sunlight as much as possible. Never apply heat directly to a chlorine container. Heaters which are used to heat Well Houses and chlorinators must be located where the heat rays are directed away from chlorine containers.

A Flame Permit must be secured before welding, burning, or soldering work can be accomplished.

Never drop chlorine containers and do not permit them to strike each other violently. Keep containers secured in upright position.

Always open chlorine container valve slowly and with proper wrench.

Only one chlorine container will be permitted at each chlorination station. (Editor's Note: Para. 137c, TM 5-665, requires two or more 150 pound chlorine cylinders to be connected in parallel if the rate of the withdrawal exceeds 35 pounds in 24 hours.)

REMEMBER - proper gas masks are located in special containers, attached to outside wall of each Well House and at other chlorinating stations. Be sure you know how to use the gas mask. If in doubt - Notify the Safety Department.

In all cases of exposure to chlorine leaks, procedures of Louisiana Army Ammunition Plant are to notify the Fire Department immediately so oxygen can be administered to the injured. Obtain medical aid as soon as possible.

4. Mechanical precautions.

a. The Final Filtration and Imhoff Tanks at the sewage disposal plant are equipped with guard rails. Safety chains are attached intermittently to the guard rails of the Imhoff Tank in the event an employee should fall into the tank.

b. Good housekeeping is a mandatory requirement in the sewer system operation. Floors are kept clean and dry to prevent slipping.

c. Permanent ladders are installed in the sewer lift stations.

d. The machinery used in the operation of the sewer lift stations is inspected and lubricated weekly.

e. Dumping or using of cleaning solvents and other petroleum in the sewage system is prohibited.

f. A portable forced-air system is available for use should the mechanical forced-air ventilation system be inoperative in a sewer lift station.

Safety regulations, thoroughly understood and carefully followed by the personnel involved, should reduce to a minimum the likelihood of an accident being encountered during the operation and maintenance of a sewer lift station and sewage disposal plant.

Editor's Note: Safety in Sewage Disposal is a complex problem. The above article treats some important aspects of this problem but omits others which are of equal importance. It is recommended that Safety in Wastewater Works, Method of Practice #1, 1959, Water Pollution Control Federation, 4435 Wisconsin Avenue, Washington, D. C., 20016 be used for more definitive guidance.

PRESIDENTIAL PROCLAMATIONS

The President has designated the week beginning 28 June 1964 as National Safe Boating Week, and

The week beginning 19 July 1964 as National Farm Safety Week.

AMC Subordinate Commands, installations and activities are urged to support safety in these areas.

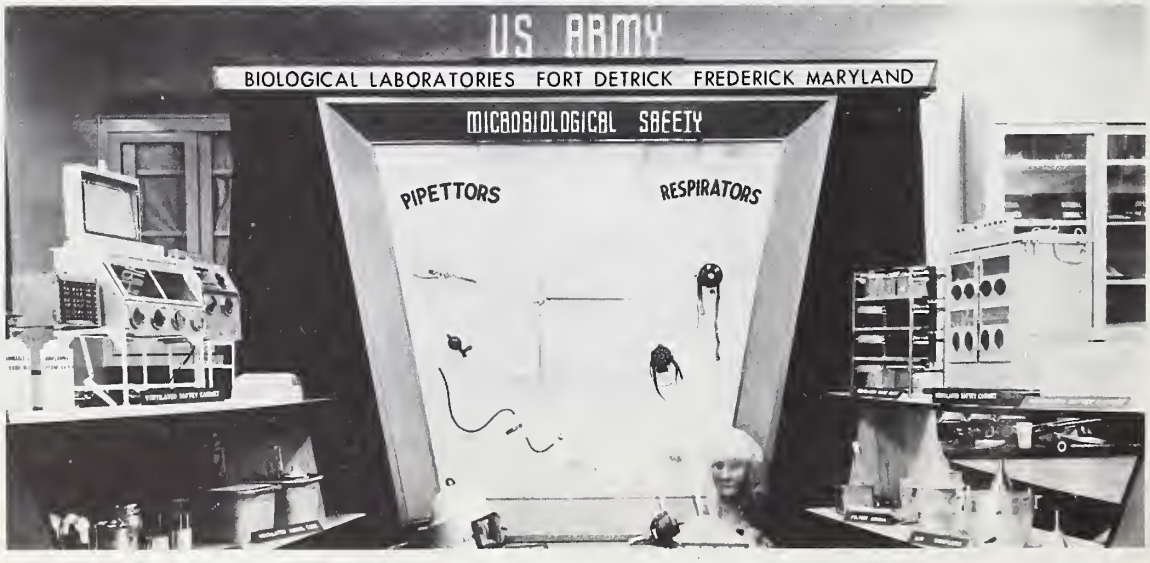
EXHIBITS PROMOTE MICROBIOLOGICAL SAFETY

Everett Hanel, Industrial Health and Safety Division
U. S. Army Biological Laboratories, Ft. Detrick

Microbiological safety, the prevention of occupational infectious disease, is a subject of concern in laboratory and research institutions where pathogenic microbes are handled.

In an effort to share specialized information on this subject with other interested individuals and organizations, the Safety Division of the U. S. Army Biological Laboratories at Fort Detrick periodically presents technical exhibits on microbiological safety at various scientific meetings and conventions. During the past 13 years, safety exhibits have been shown 37 times at the annual meetings of such organizations as the American Society for Microbiology, the American Public Health Association, the American Medical Association, the American Medical Technologists Association, the American Veterinary Medical Association, the American Chemical Society, the National Tuberculosis Association, and the President's Conference on Occupational Safety.

The content of the exhibit has changed through the years to reflect the latest findings and safety equipment useful in reducing laboratory exposure risks. Special emphasis has been given, for example, to respiratory protective devices, air sampling apparatus and ventilated cabinets for infectious laboratory work. A special exhibit has also been devoted to safety measures used when carrying out experiments with aerosols of infectious microbes.



Microbiological Safety Exhibit

NON-VENTILATED ISOLATION CAGES FOR ANIMALS

Sam P. Bailey and G. Briggs Phillips
U. S. Army Biological Laboratories, Ft. Detrick

It is frequently necessary to place laboratory animals exposed to infectious or toxic materials in isolation cages to assure that aerosols from the animals do not reach the animal caretakers and are not transferred to other nearby animals. With animals used in respiratory disease studies, this is usually done by placing the animals in separately ventilated cages or compartments. For field tests and in situations where ventilating equipment is not available, an alternate type of isolation cage is needed. Prototypes of non-ventilated isolation cages of a type originally developed by Dr. Lizbeth Kraft at Yale University have been designed and tested at Fort Detrick as a possible answer to this problem.

One such prototype cage for mice is shown in Photo 1. The cage is made from two large plastic Petri plates - one for the top and one for the bottom of the cage. The sides are made from aluminum screening which is sealed to the bottom with polyester resin (liquid fiber glass). One layer of FG-50 fiber glass filter media is wrapped around the screening and sealed with polyester resin.

Two types of tests were done with these cages, the first to see how many mice could be housed in the cage and the second to determine the efficiency of the filter material in preventing the escape of bacterial aerosols.

The tests showed the cages to be suitable for housing up to three mice each. Prolonged holding of mice under more crowded conditions, for example five, seven or nine mice per cage, produced no obvious physical harm to the animals, but their rate of weight gain was not equivalent to that of mice held in open cages. With three mice per cage, the weight gains were normal and the animals remained active and healthy for holding periods of at least 21 days.

Tests with bacterial aerosols further showed that there was no outward leakage of aerosol through the filter media even when as many as 10^7 particles per liter of air were present on the inside of the cage.

On the basis of these tests, design criteria were established as an aid to those who may wish to use containment cages of this type. The suggested cage volumes and amount of filter area per 100 grams of animal are shown in Table 1.

Photo shows non-ventilated isolation cage for laboratory mice.

Table 1

Design Factors for Non-Ventilated Isolation Cages

	Per 100 grams of animal
Cage volume	2350 cm^3
Filter area	525 cm^2

For further details on the construction and use of these isolation cages, readers are invited to contact Safety Division, Fort Detrick, Frederick, Maryland.

USING COMPRESSED AIR FOR BREATHING

C. D. Attaway, Safety and Security Director, Thiokol Chemical Corp.
Longhorn Army Ammunition Plant

The use of compressed air systems for supplying breathing air has greatly increased in recent years due to the need of increased protection against highly toxic materials used in missile and rocket fuel production. While supplied air breathing systems, in general, give greater assurance of complete protection in toxic atmospheres than canister masks, certain factors inherent in the mechanical compression and distribution of respirable air must be considered in evaluating the over-all protection achieved.

The quality of compressed air delivered by a compressor is affected by two principal factors:

1. The presence of certain contaminants in the air supply or intake of the compressor. These include materials such as dusts, exhaust gases, odorous or toxic gases and vapors, and other contaminants in ambient air. The amounts present will depend upon the location of the compressor intake and the effectiveness of filters provided.

2. Materials added to the air during compression and distribution delivery. Examples are oil mists and vapors, carbon monoxide, aldehydes, oxides of nitrogen, and water vapor. If an oil lubricated compressor is permitted to overheat, the products of partial combustion and decomposition become very important, since considerable amounts of carbon monoxide, aldehyde and nitrogen oxides may result. The air delivered to some point for breathing purposes may contain one or more of these contaminants as well as scale, rust or other line deposits.

Air entering the compressor must be uncontaminated (respirable). A possible means for attaining this is to locate the air intake for the compressor as remote as possible from contaminants such as exhausts of other internal combustion engines, sewer manholes, sandblasting, painting and spraying, sources of smoke, welding fumes, and toxic gases and vapors. Intakes should be provided with filters for removing dust or other particles in the respirable size ranges.

Although the level of contamination may not exceed such accepted safe limits as those set by the American Conference of Governmental Industrial Hygienists and other accepted authorities, the presence of any detectable amount of carbon monoxide in breathing air is a definite sign of some source of contamination. Unless verified by

numerous tests, such contamination cannot be considered as average value or even a maximum value. Many factors may cause the levels to rise or fall. Therefore any contamination should be critically regarded from the following viewpoints:

1. A possible uncontrolled hazard.

2. A preventable hazard that should be removed.

Foresight requires that all compressed breathing air systems be checked before human use as well as after they have been in operation for a period of time.

Centralized compressed air systems providing breathing air require careful selection and location of equipment. Maintenance of compressors and all filters must be of high quality. High temperature shut-off or alarms for compressors are highly desirable. Most effective of all is a continuous monitoring instrument which gives an alarm or signal before carbon monoxide concentrations reach the maximum level permissible for the type of air being monitored. The minimum safety precaution should be a spot checking and analyzing of the compressed breathing air at frequent intervals.

Portable compressors using gasoline engines are most likely to recycle quantities of carbon monoxide from engine exhaust.

Diesel engine powered compressors have less serious exhaust problems, but exhaust stacks should be extended to prevent recycling.

Rotary or rotary screw type compressors are favored over piston or reciprocating types, although replacement of filters, compressor maintenance, and degree of overheating remain important factors. Age of compressors is of less importance than the quality of maintenance of such units.

Certainly the most hazardous condition is created when high temperature decomposes lubricating oil, generating carbon monoxide, aldehyde and oxides of nitrogen. This can be largely avoided by employing a compressor not requiring oil lubricants, such as a roto-screw compressor or by providing an automatic high-temperature alarm or shut-off mechanism for the compressor. It is essential that the maintenance and operation of compressors be in accordance with the manufacturer's instructions, with specific attention given to cooling of compression chambers, and to the condition of piston rings, oil consumption, driers, filters, and other accessories.

Filtration of the air between the compressor and the air-line respirator is recommended for the removal of pipe scale, rust, oil droplets and condensed water. Even the use of an activated charcoal filter for removal of objectionable odors is recommended.

It must be pointed out that carbon monoxide is not removed by activated charcoal or mechanical filters and therefore poses the greatest of all contaminant threats if not otherwise prevented. The removal of carbon monoxide in toxic atmospheres by canister gas masks is accomplished by a material called Hopcalite, but the use of this material as a filter is not practical for air systems because it is rapidly deactivated by the moisture and other materials in compressed air.

Carbon monoxide is a silent killer. It is a colorless, odorless, tasteless and non-irritating gas that is highly toxic. The blood hemoglobin has an affinity for carbon monoxide about 300 times greater than for oxygen; consequently, the absorption of the poisonous gas is quite rapid. A concentration in air of only .02 per cent (only two parts in 10,000) may produce primary symptoms of headache, mental dullness, nausea, dizziness or physical logginess in a one-hour exposure. Unfortunately, these are very common symptoms, and the victim may disregard them as having no connection with carbon monoxide poisoning.

Going further, a concentration of only .06 per cent in air may produce unconsciousness in two hours, while .1 per cent may produce coma and collapse in a little more than an hour and prove fatal in four hours. Higher concentrations may cause immediate unconsciousness and death within a few minutes. There is no acquired or natural immunity to the gas. Obviously there is a vital need for a positive means for establishing the fact that carbon monoxide is present even in low but exceedingly dangerous concentrations.

DON'T PLAY
"RUSHIN' ROULETTE" ! ! !

The principal cause of accidents is the
MAN BEHIND THE WHEEL

CURRENT EVENTS

HE SKIDDED INTO SPACE

The employee made his exit from the building on to the attached platform where he had parked his bicycle. He mounted the bicycle and pedaled toward a ramp. When he had traveled about 35 feet, he rode through a puddle of water. The tires skidded on the wet surface, and the bicycle and its rider went over the edge of the three-foot high platform.

The employee later recalled that the front wheel of the bicycle dropped when he rode off the platform. He went over the handle bars, and his head struck one of the rails of the railroad that paralleled the building. A short time later a fellow employee found him leaning against the platform a few feet from the spot where he had skidded over the side. Fractures of two vertebrae and lacerations of the scalp, face and hands were so severe as to cause three weeks lost time.

Corrective actions included publication of written instructions to prohibit bicycle riding inside buildings and on ramps and platforms and the establishment of a requirement that shop personnel brush water puddles from building platforms.

OVERHEATED APARTMENT GETS HOTTER

Workmen had finished painting vacant Apartment A in the two-apartment Capehart construction building. When they departed, they left in operation a gas water heater and a 100,000 BTU-per hour gas-fired, forced-air furnace. The thermostat was set at 85° F.

Early in the morning ten days later, occupants of Apartment B discovered and reported that Apartment A was burning. Firefighters arrived and extinguished the fire. Estimated damage to the furnace, water heater, flooring, walls, roof, ceiling and wiring exceeded $7,600. The hottest fire was observed to be in the vicinity of the overhead furnace room, where it appeared to have started. The fire was estimated to have burned about six hours before it was discovered.

Corrective action included establishing a requirement for closer inspection and testing of furnace and water heaters. Prompt action would be taken to repair any defects. Gas water heaters would be turned off in vacant apartments, and the furnace thermostat would be set at 65°.

OVERHEAD GUARD SAVES DRIVER

The operator of a one-ton electric forklift was moving a pallet load from one warehouse into another. Operating in reverse gear, he started through an open doorway. When the lift was directly under the steel, power-operated overhead door, he saw that it was being lowered. He tried to drive his forklift forward but it was too late. The descending door struck the forklift guard squarely above the head of the driver. The guard saved him from injury. About $100 damage was done to the door.

Although no witnesses could be found, it was concluded that someone inside had pressed the "down" button and passed on into another room without noticing the approach of the electric forklift. The warehousemen were instructed to close doors only after making certain they were clear and that no trucks were about to enter. Drivers were cautioned to watch for closing doors. (Editor's Note: In order to prevent this accident from recurring, consideration should be given to installing an automatic alarm system which would operate when the door is descending. A clutch could be installed which would disengage the drive when obstruction is encountered.)

SLOW-MOTION TURNOVER

A 10-ton trailer was parked overnight after being loaded with metal parts that were to be used at another location within the installation. Early the next morning a driver came with a tractor to move the trailer. Finding it locked and sealed, he did not check the positioning of the load and he forgot to check the tires. He completed his hookup and started for his destination.

The route included a ninety degree left turn from one highway on to another. The terrain was level and the intersection was clear when the driver made the turn at a speed between 15 and 20 miles per hour. As he rounded the corner, he became aware of a shifting in the trailer's load. Looking at his mirror, he saw the left rear wheel of the trailer rise from the ground. The sideward motion of the trailer continued until it toppled on its right side, overturning the tractor with it. The vehicle then slid about three feet on its side, causing $750 damage. The driver's injuries were confined to minor lacerations on his hands.

Inspection of the overturned trailer revealed that the right rear inside tire was deflated. Centrifugal force on the turning trailer with the added force exerted by the shifting of an improperly positioned load were identified to be the causes of the upset. Corrective action included strict enforcement of rules for checking tires and loads before trailers are pulled.

Improperly inflated tire and shifting load on curve caused this.

GET FULL VALUE FROM YOUR SOP

The hard work of preparing a standing operating procedure for an explosives operation is often followed by failure to get full value for the effort expended. This is borne out by the fact that noncompliance with some part of an SOP has caused many explosives accidents.

The SOP for any process involving explosives or other hazardous materials is more than a set of instructions for accomplishing a task. It is a safety operating procedure. The omission of performance of any step in the prescribed procedure may be an invitation for disaster in the form of fire, explosion, injury and death.

If the maximum possible degree of safety is to be achieved in the performance of an operation involving hazardous materials, all steps of the operation must be carefully planned and engineered, a complete and clear SOP must be prepared, and the SOP must be followed without deviation.

The SOP is the document that tells how the job must be done if it is to be done safely. It should provide the following information:

a. A name that clearly identifies it.

b. The designation of the building or the area involved in the operation.

c. A statement of the work to be done.

d. A complete list of the names, types, and amount of munitions, explosives, toxics, or other hazardous materials used in the operation.

e. Identification of the hazards involved with the materials to be handled.

f. A list of pertinent references.

g. A specific list of the protective clothing and equipment required to be worn and used, and when and to whom these requirements are applicable.

h. Any special care to be given to the protective clothing or equipment used in the operation.

i. The requirements for fire extinguishers and the firefighting practices to be used should be clearly stated. Persons to combat fires should be designated and trained as appropriate.

j. Required first-aid personnel, equipment and supplies should be identified.

k. Necessary special ventilation should be stated.

l. The number, types and location of barricades, shields and safety showers should be identified.

m. The required step-by-step operating procedure should be clearly and concisely stated. It should include the correct disposal of waste, scrap and rejected material.

n. Personnel limits and hazardous materials quantity limits should be stated. These limits should conform to requirements of paragraph 1601, AMCR 385-224.

o. An emergency procedure should be clearly stated. It should include instructions for evacuation of personnel and should identify those seriously hazardous conditions under which evacuation of personnel should be effected.

p. The required usage and location of special tools or equipment should be identified.

q. Specific instructions for all operating personnel should be provided. These should include the following:

1. All personnel involved should read and understand applicable portions of the SOP.

2. Opportunity should be given to all personnel to obtain answers to questions about their part of the SOP.

3. No person should deviate from the SOP unless he is granted specific permission by a person authorized to approve the deviation.

4. Each person should thoroughly acquaint himself with each step of the operation he performs before he commences work.

The operating supervisor should be responsible for the following activities relative to the SOP:

a. He should make certain that the SOP is coordinated with the safety program and the other applicable programs of the installation.

b. He should specify the methods used to orient, train and supervise new and old employees in correct job procedures.

c. He is accountable for the safety of all personnel assigned to his supervision.

d. He should post applicable portions of the SOP in a conspicuous location where it can be seen by the individual workers in each building or operating portion of a building.

e. He should post and secure full compliance with the explosives and personnel limits.

f. He should post the correct fire symbols on the buildings or locations used in the operation.

g. He should obtain full compliance with the SOP. No deviation should be permitted without the permission of higher echelon personnel authorized to approve the exception.

h. Inspections should be performed daily to insure that all prescribed procedures are followed. A daily log of the operation should be maintained.

The SOP should be approved by the Commanding Officer or a qualified member of his staff who has been delegated the responsibility for review of and approval of SOP's.

The installation should comply with the requirements the next higher command may have established for review and approval of the SOP.

The work of planning, preparing, and posting an SOP, no matter how thoroughly done, will not guarantee a safe explosives operation. The SOP should be understood and adhered to fully and without deviation if the planned safety benefits are to be collected.

EXPLOSIVES SAFETY

SPECIAL EQUIPMENT FOR PROPELLANT TRANSFER

Robert A. Jordan, Line Foreman, Hercules Powder Company
Radford Army Ammunition Plant

The transfer of small base grain particles, used in the manufacture of high impulse solid fueled rocket motors, from one container to another is a sensitive and potentially hazardous operation. At Radford Army Ammunition Plant, the practice of manually dumping base grain propellant from drying trays into copper buggies was considered undesirable because of the degree of personnel exposure involved and the possibility of serious injury should an incident occur. To correct this condition, Hercules Powder Company initiated a program to upgrade the drying and propellant transfer operations with special emphasis being given to reduction of personnel exposure.

Formerly, base grain propellant from the graining operation was poured into trays which, in turn, were placed in wooden cabinets. The loaded cabinets were transported to the dry house and the propellant filled trays were removed and stacked for drying. Transfer of the dried propellant from tray to buggy was accomplished manually in the confined space of the dry house. To do this, an operator picked up the tray and hand dumped its contents into a buggy positioned beside him. It was not unusual for one man to dump from 1,000 to 1,200 trays within an 8-hour shift. Should ignition of the propellant have occurred, there was a high degree of probability that serious injury would have occurred even though every man wore protective clothing.

The program study revealed a need for several new items of equipment.

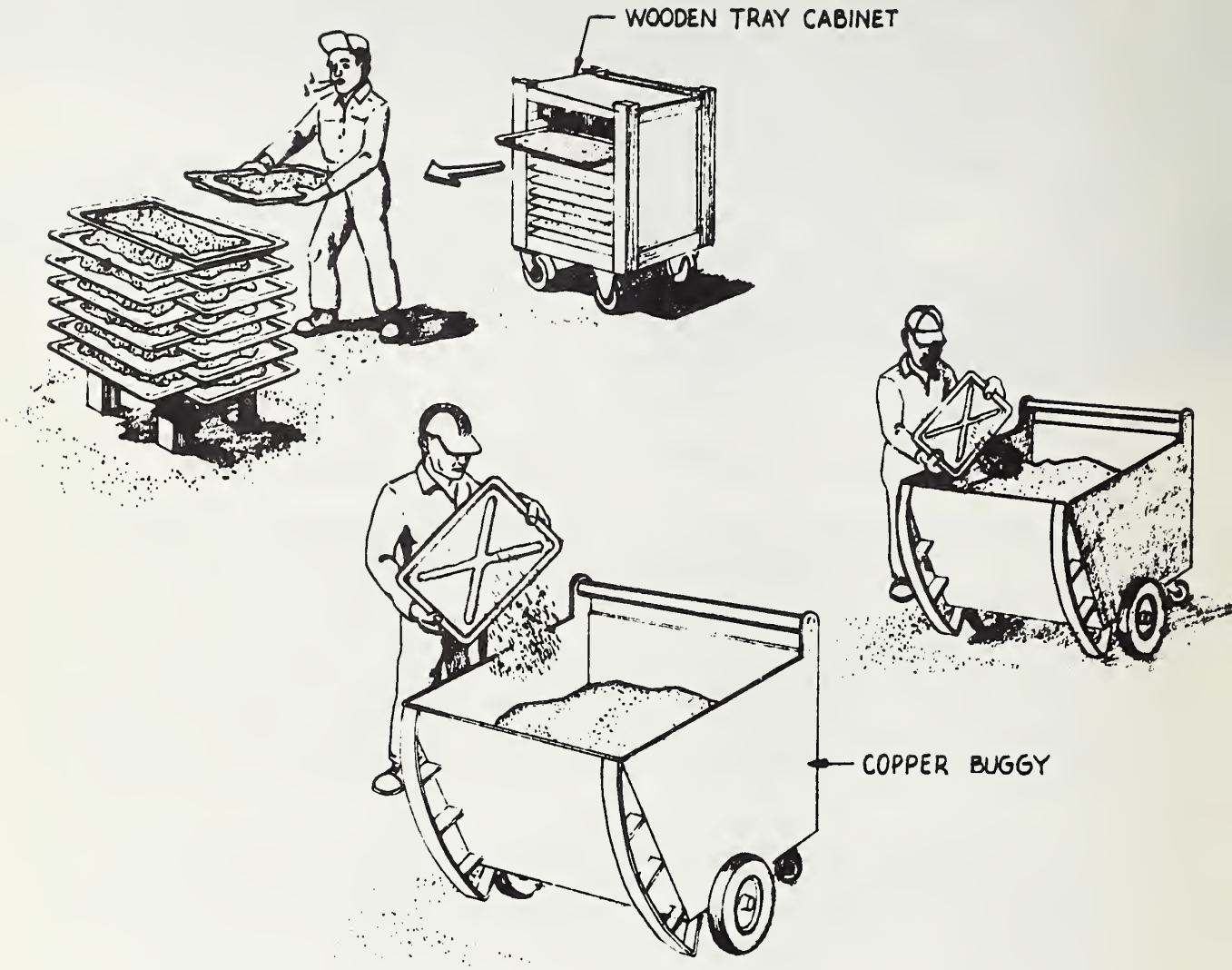
First, an aluminum cabinet was designed to hold 18 aluminum drying trays stacked in layer fashion. Each tray is 38" long, 26" wide and 1 1/2" deep, and holds approximately 20 pounds of base grain propellant. The back and front of the cabinet are open and a removable aluminum bar permits loading and unloading of trays. Development of the aluminum cabinet and trays eliminated the need for removing trays from the cabinets and stacking them in the dry house to obtain proper drying.

Next, a hydraulically-powered dumping device, which will rotate the cabinet through a 130° arc, was installed in a building separated from the drying area. The cabinet to be dumped is positioned on the dumping platform and locked in place. The dumping mechanism rotates the cabinet 130° to completely empty the trays of all propellant. A large stainless steel hopper beneath the dumping mechanism channels propellant into a waiting copper buggy.

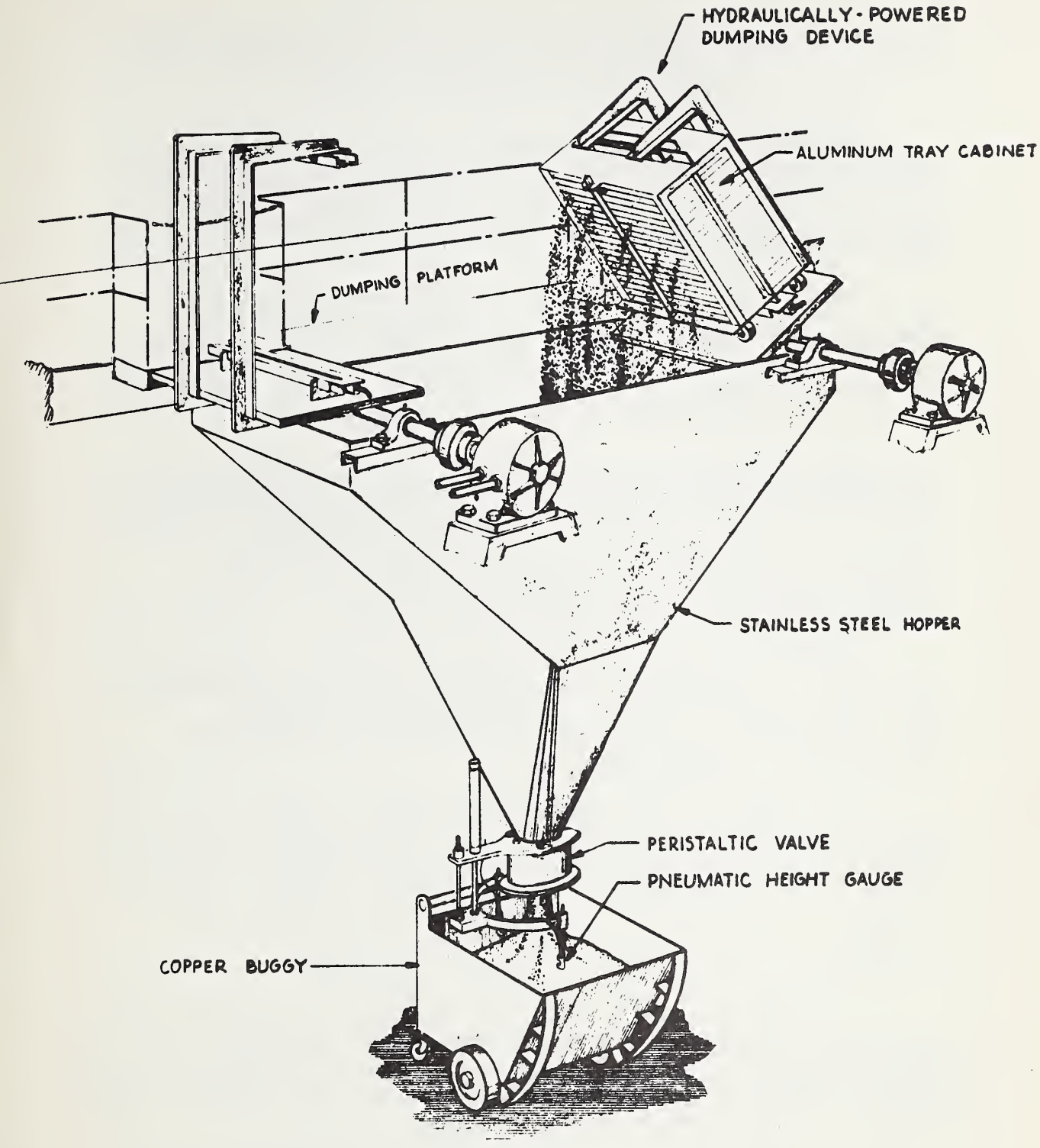
When the buggy is filled to the desired level, the flow of propellant from the hopper is automatically stopped through functioning of a peristaltic valve. Functioning of this valve is controlled by a pneumatic height gage. The gage, which emits a controlled flow of inert gas into the buggy, is actuated by two adjustable arms. When the gas flow is interrupted at either source, in this case by the propellant piling up in the buggy, a signal is sent to the peristaltic valve which in turn closes, stopping propellant flow.

Through the use of this new equipment, personnel exposure has been reduced throughout the entire process and has been completely eliminated during the hazardous dumping operation. Personnel enter the building only to engage cabinets on the dumpers, disengage them and to position additional buggies to receive the emptied propellant. Since all controls are located in a steel personnel shelter 75 feet from the building, physical handling and exposure during dumping operations are no longer required.

The development and fabrication of the processing equipment just described marks the completion of the program study. The study has been successful and another hazard in propellant processing has been eliminated.



MANUALLY DUMPING BASE GRAIN



REMOTE CONTROLLED BASE GRAIN DUMPING

IMPROVED PRIMER STORAGE

Edwin C. Wood, Chief, Safety, Security & Intelligence Office
Cincinnati Procurement District

Problem! How can a privately-owned, privately-operated plant store more than 15 pounds of explosives in the form of XM 94 primers in a service magazine built to confine half that much? By the way, we cannot use any more floor space inside the plant building.

The service magazine is an 8-foot by 8-foot room, seven feet high, anchored to a concrete floor. It is located five feet from an outside wall. Three sides are made of 1-inch mild steel plates welded together and welded to a 2-inch mild steel roof plate. The fourth side is open and facing an outside wall (Figure 1).

XM 94 primers (in the packing boxes), completed slide assemblies placed in magazines (Figure 2), and rejects had been stored on shelves in the service magazine. The shelves permitted storage of considerably more than the allowable explosives. This, in itself, presented a hazard because if there is storage room on a shelf, someone will take advantage of it.

The Safety Office, Cincinnati Procurement District, was asked to help solve the problem. It was determined that the company would have to store XM 94 primers, slide assemblies in "peg board" layers, and slide assemblies in magazines.

A cutaway of a peg board is shown in Figure 3. These peg boards are used to permit an operator to charge semi-automatic assembly machines. He can remove the loaded slide assemblies from a peg board easily, one at a time, and place them in a position for assembly into a casting. This machine supplements production when a stoppage occurs in the automatic equipment.

The slide assembly magazines (Figure 2) accomplishes the same function on the fully automatic equipment. A small quantity of primers, stored in their compartmentalized packing cases, are kept on hand to supply the machine that loads them into the slide assemblies.

The Safety Office, Cincinnati Procurement District, after considering the problem, suggested a 1-inch thick mild steel partition through the center of the servicing magazine to permit a total of 15 pounds of explosives in the magazine. This is permissible, but the danger of overloading would still exist.

The best solution demanded an inexpensive reinforced storage for the maximum allowable number of primers with a dependable guarantee that the allowable limits would not be exceeded. The Safety Officer, Cincinnati Procurement District, designed and suggested a nest of pipes (Figures 4 and 5) to hold the slide assembly magazines. The nest of pipes that would hold the maximum allowable number of primers loaded into slide assemblies and placed in magazines conveniently permitted a rack of 171 pipes (9 X 19). This left sufficient air space all around the nest of pipes to help absorb the shock of an explosion.

The company tested the pipe with approximately 13 per cent more explosives (Flexible Linear Shaped Charge used to detonate all 195 primers simultaneously). The pipe withstood the test with no damage to the pipe discernible from visual or X-ray examination.

It was recommended that the peg boards be stored in steel ammunition cases in the other half of the magazine. A rack was designed to hold only enough cases to stay within the explosive limits.

Primers are kept in a heavy steel chest that will hold only one wooden box of 5,000 primers. The primers are removed, a tray at a time, to supply the production line. This assures maximum protection to the primers while they are in their most hazardous state.

The entire recommendation was reviewed and was considered satisfactory and the magazine was remodeled. The combined efforts of the Plant Engineer and the Cincinnati Procurement District Safety Officer doubled the amount of primers that could be stored safely, precluded overloading, improved housekeeping and reduced the hazard to employees without occupying additional floor space.

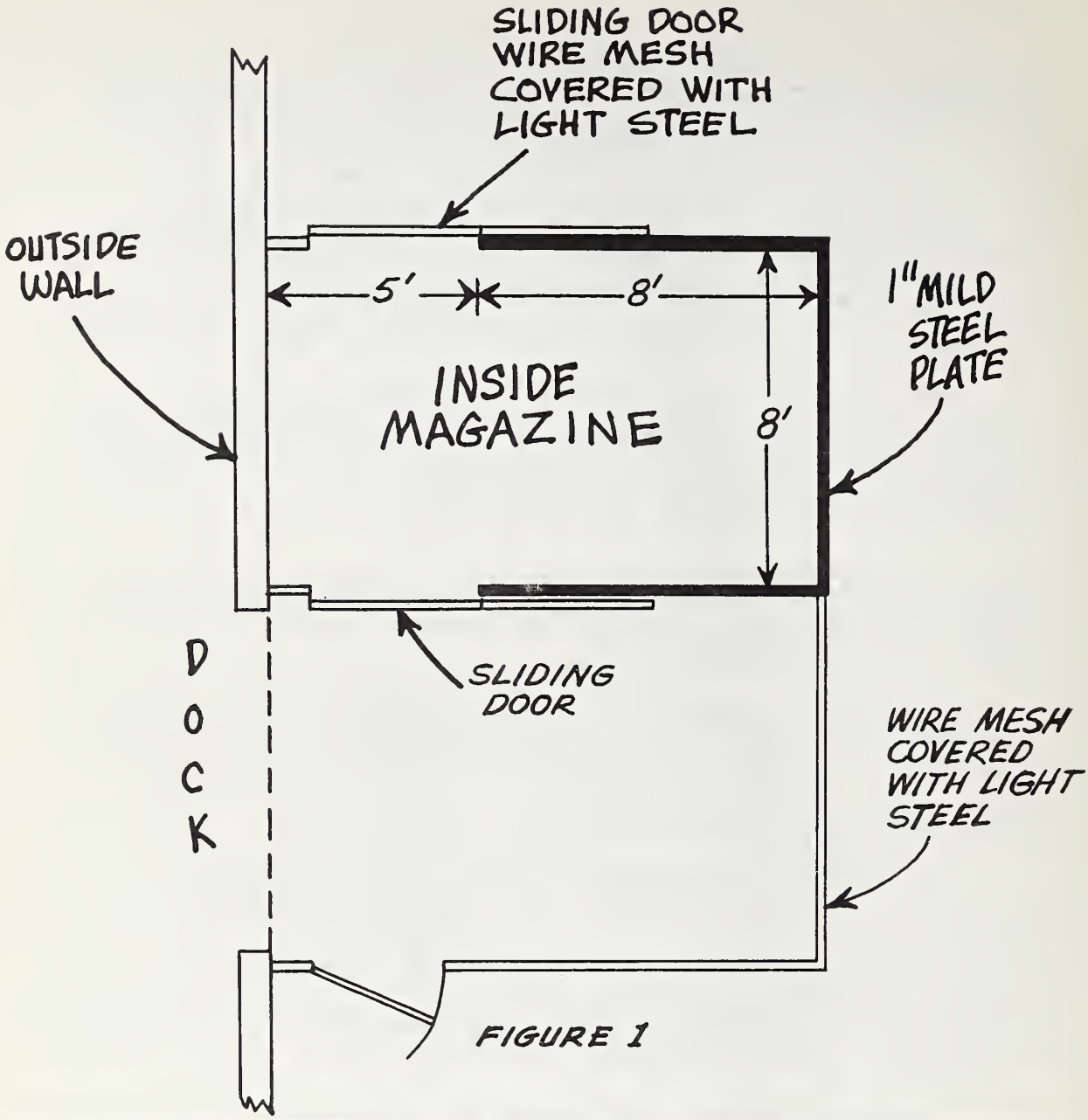
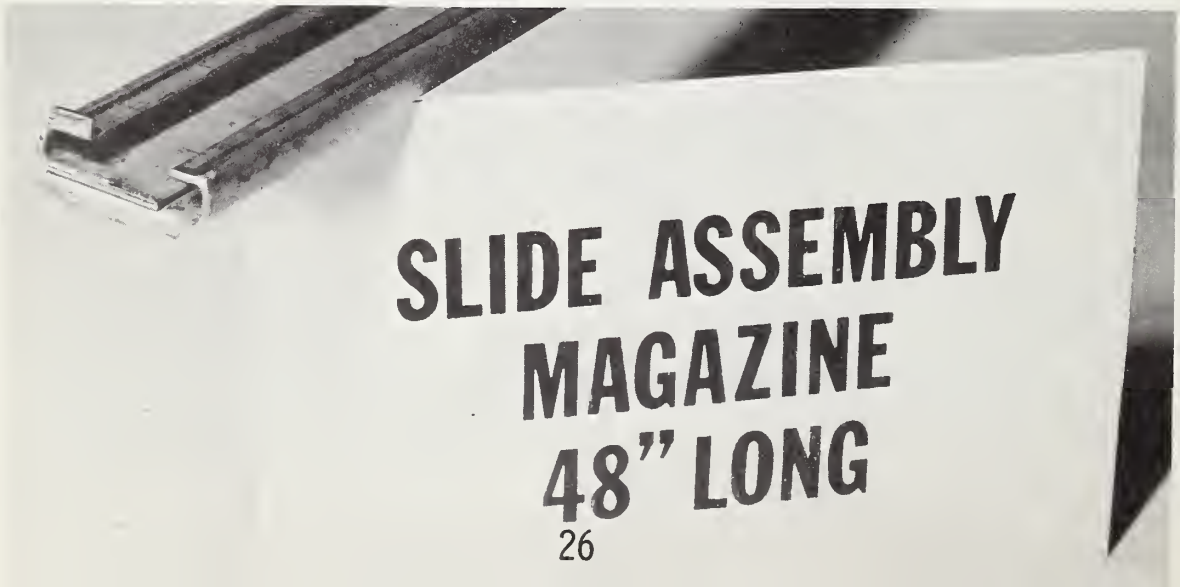

SLIDING DOOR
WIRE MESH
COVERED WITH
LIGHT STEEL
OUTSIDE
WALL
5'
8'
1" MILD
STEEL
PLATE
INSIDE
MAGAZINE
8'
D
O
C
K
SLIDING
DOOR
WIRE MESH
COVERED
WITH LIGHT
STEEL

FIGURE 1


SLIDE ASSEMBLY
MAGAZINE
48" LONG

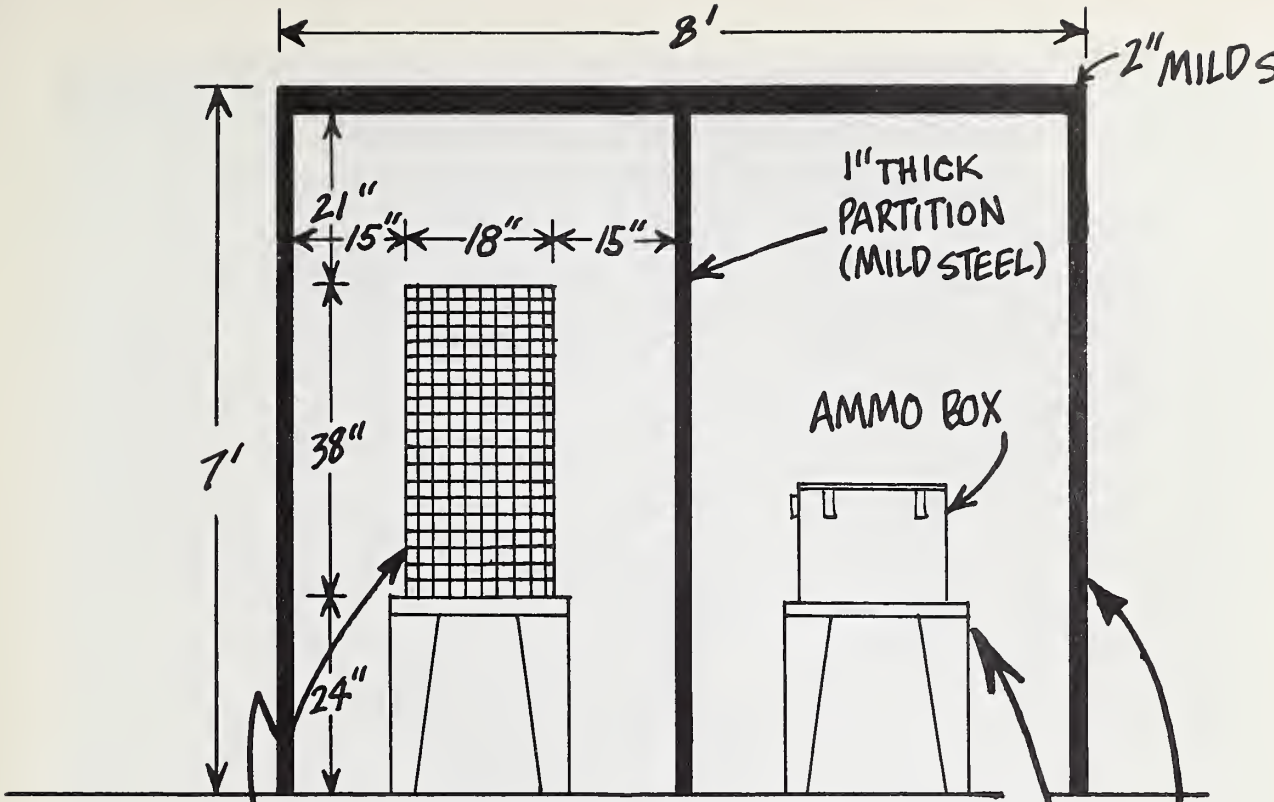
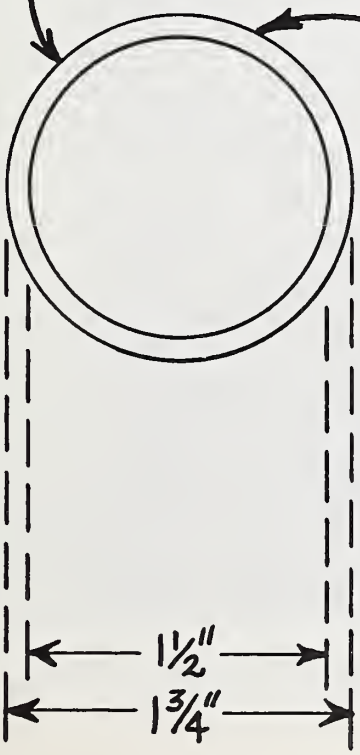


FIGURE 4

EACH SQUARE REPRESENTS ONE PIPE



CODE 80 EXTRA HEAVY BLACK IRON PIPE

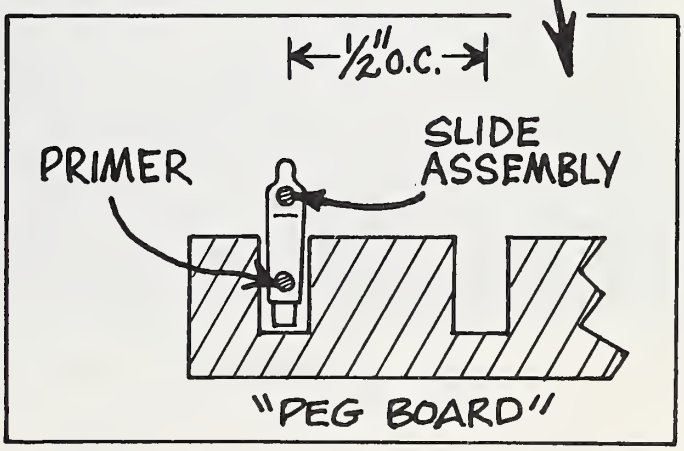
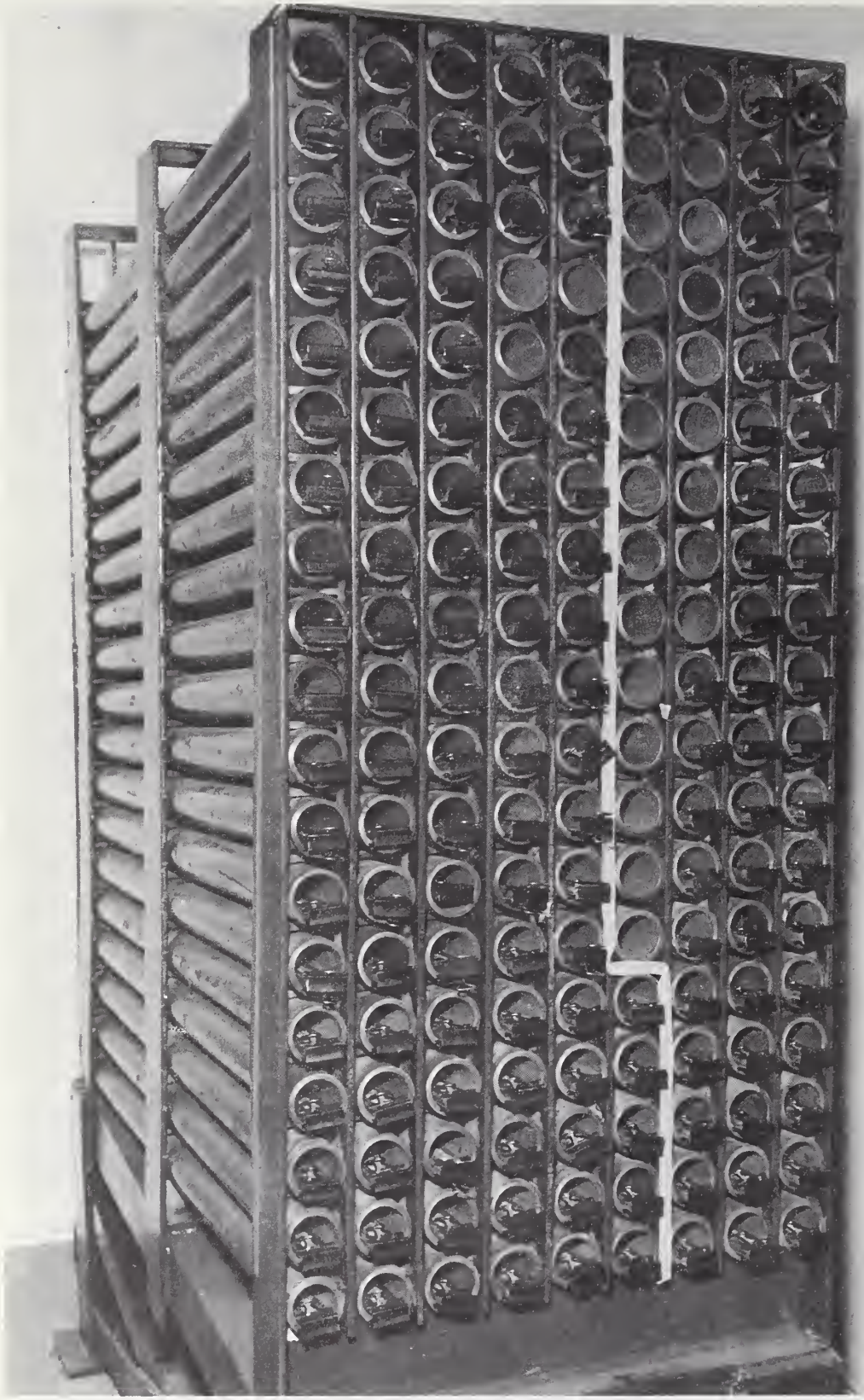


FIGURE 3



Nest of Pipes Used to Store XM 94 Primers

AUTOMATIC LIGHTING UNIT EXPLOSION

Division of Operational Safety, U. S. Atomic Energy Commission

An automatic lighting unit was taken to the electrical shop for replacement of one lamp. On completion of the work, the unit was plugged into the 110-volt circuit in the electrical shop in order to see if the unit was functioning properly. The following day an electrician pressed the "test" button and an explosion took place. The force of the explosion (Editor's note: presumably of hydrogen) forced open the door of the unit and split the nickel-cadmium battery on two sides. The damage to the unit is noted in the photographs. The electrician who depressed the "test" button sustained a bruised hand as a result of the explosion.

Representatives of AEC contractors and AEC met with the fabricator in order to discuss the accident. Although no positive causative factors could be reached, the following observations were made:

1. The lighting unit utilizes a type TA-4 nickel cadmium battery.

2. The electrolyte used in the batter is a solution of potassium hydroxide in distilled water.

3. The units are fabricated by a company using UL listed parts; however, the overall unit is not UL listed.

4. There are approximately 150 automatic lighting units in use at this location. No difficulties have been experienced to date with other units.

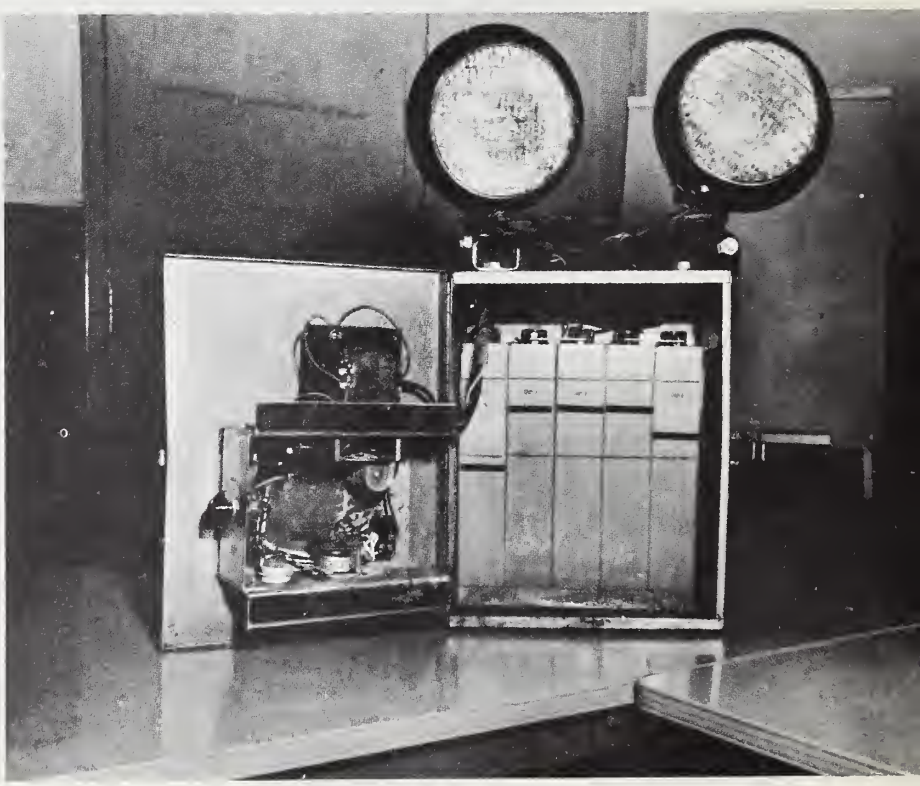
5. The case is watertight but not gastight.

6. There is no barrier between electrical components and storage batteries.

7. The voltage on the charger was not measured prior to the explosion.

In order to prevent a recurrence of this type of accident, ventholes are being cut in the top and bottom of all of these automatic lighting units. This will allow any excess gas that may be produced to escape from the container. The installation of a baffle between the electrical components and the batteries is also being considered. The manufacturer recommends that the voltage be measured on a periodic basis to insure that the batteries are not overcharging. According to the fabricator company representative, the charging voltage should never exceed seven volts. The damaged battery has been returned to the manufacturer for their examination.

Note deformation of door caused by force of explosion

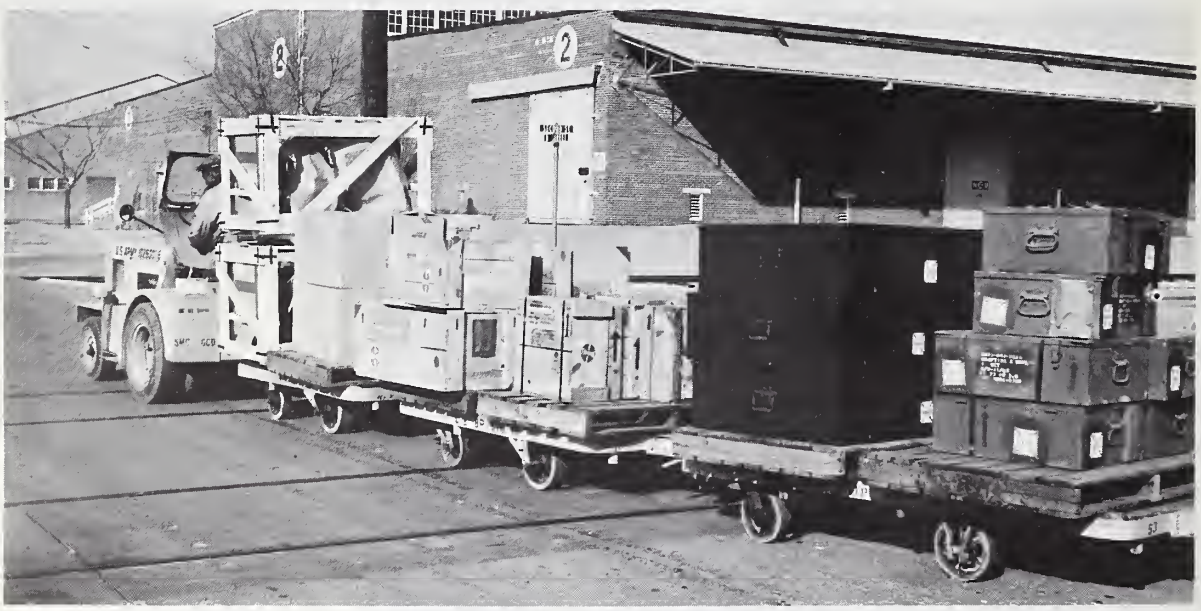


▬▬ = Electrolyte level in cells after explosion

EMPTY AEROSOL CANS ARE HAZARDOUS

Aerosol containers are common in the kitchens, bathrooms and utility rooms of most homes. The cans bear a printed warning that the contents are under pressure and against puncturing and exposing to heat. The picture above shows the reason for the warning. It is the remains of an "empty" can that was discarded with waste paper in a trash barrel. When the paper was burned, the can exploded. Fortunately no one was injured.

REAR-VIEW MIRROR AIDS TRACTOR OPERATOR



The Granite City Army Depot has made operation of its warehouse tractors safer by installing rear-view mirrors. The mirror is particularly helpful when tall loads or more than one trailer are being hauled. The operator can watch his load, without frequent turns in his seat that take his eye away from the road. The mirrors were installed at a cost of about $8.00 each for labor and materials, after adoption of a safety suggestion.

DO YOU KNOW?

Here are ten questions that will test your knowledge of a variety of safety requirements. The answers to all of them may be found in AMCR 385-224. How many can you answer without a quick search of the regulation? The correct answers and references are shown on pages 38 and 39.

1. What minimum distance separation is required between primary and secondary overhead transmission lines and buildings containing explosives?

   Answer:

   Reference:

2. How long should a newly installed grinding wheel be run at operating speed before it is first used?

   Answer:

   Reference:

3. Refueling of gasoline and diesel powered equipment used in warehouses and inert buildings must be accomplished at what distance from the warehouse or building?

   Answer:

   Reference:

4. What training manual describes the program that must be followed in the selection and training of personnel to operate powered materials handling equipment?

   Answer:

   Reference:

5. What magazine instruction placard must be posted on or near each door of the magazine so that it is visible when work is being done inside?

   Answer:

   Reference:

6. In placing a portable or extension ladder, how far from the wall or object against which it is leaning should the foot of the ladder be placed?

   Answer:

   Reference:

7. In a building where different kinds of explosives are present, what determines the fire hazard symbol that will be used?

   Answer:

   Reference:

8. What temperature, over what period of time, is considered critical in a storage magazine?

   Answer:

   Reference:

9. Where it is necessary for employees on scaffolds to crawl out on thrust-outs or projecting beams, what protective equipment must be worn?

   Answer:

   Reference:

10. In the event of a misfire of an explosive cartridge actuated hand tool, how long should the tool be held in the operating position before the explosive cartridge is removed?

    Answer:

    Reference:

Presentation of AMC Award of Honor for Safety At Joliet Arsenal

Major General Floyd A. Hansen, left, Commanding General of the U. S. Army Munitions Command, presented the Army Materiel Command's Award of Honor for Safety to Joliet Arsenal. With him on the platform were (l. to r.) Howard S. Hennard, Safety and Security Superintendent, U. S. Rubber Company; J. E. Whitley, Office of Contracting Officer's Representative of the Arsenal's Kankakee Unit; Oscar Zellweger, Plant Manager, U. S. Rubber Company; Elmer Shea, Safety Director, Joliet Arsenal; Walter P. Stanckiewitz, Chief, Safety Office, Ammunition Procurement and Supply Agency; Colonel Homer C. Barber, Commanding Officer, Ammunition Procurement and Supply Agency; Colonel E. Stanton Palmer, Commanding Officer, Joliet Arsenal; and O. B. Hunt, Chief of Operations, Joliet Arsenal. The installation also won a National Safety Council Award of Honor for its FY 1963 safety performance record.

FIRE PREVENTION CONTEST AWARDS - FY 1963

Lieutenant General W. K. Wilson, Jr., Chief of Engineers has forwarded National Fire Protection Association Certificates of Merit to the following AMC installations:

Navajo Army Depot	8th place
Ravenna Army Ammunition Plant	13th place
Rocky Mountain Arsenal	14th place
Aberdeen Proving Ground	15th place
Rock Island Arsenal	19th place
Anniston Army Depot	20th place

The Secretary of the Army asked Lieutenant General Wilson to transmit these awards. The certificates were presented to the Honorable Eugene H. Merrill, Deputy Assistant Secretary of the Army (Installations) by Mr. Charles Morgan, Assistant General Manager, National Fire Protection Association, at a ceremony in Washington, D. C., on 11 March 1964.

Lieutenant General Wilson expressed the appreciation of the Secretary of the Army for the excellence of the year-round fire prevention and protection programs at the above listed installations, and the splendid efforts that resulted in the winning of these awards. The excellence of the programs is a credit to all personnel of these installations.

REFERENCE PUBLICATIONS

AMCR 385-2, 6 March 1964
Safety - Accident Reporting - Routing of Required Reports

AMCR 385-5, 18 February 1964
Safety - Safety Awards Program

AMCR 420-22, 21 January 1964
Repairs and Utilities Project Requests for Repair, Maintenance, Alteration, and Minor Construction Projects (See page 14, Safety review of drawings and specifications).

AR 385-25, 8 January 1964
Safety - Studies and Reviews, Nuclear Weapon Systems Operational Surety Program

AR 385-62, Change 1, 22 January 1964
Safety - Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat

DA Circular 385-1, 4 February 1964
Safety - Use of Cranes, Crane Shovels, Draglines, and Similar Equipment Near Electric Power Lines

NATIONAL SAFETY COUNCIL AWARDS

Each issue of the Safety Digest contains the names of Army Materiel Command installations and activities that have won National Safety Council Awards. Those that have recently qualified for or received these awards are identified below.

In most cases the awards are for periods free of injuries that cause a temporary total disability. The NSC Award of Merit is made for 1,000,000 or more man-hours of no-injury experience. The NSC Award of Honor requires a record of 3,000,000 or more no-injury man-hours.

In order to receive one of these National Safety Council Awards, an AMC installation or activity should initiate its own application promptly after a no-injury period is terminated. The application must be forwarded through the channels stated in AMC Regulation 385-5 for processing within 60 days after the end of the record period.

Applications must be made on the NSC Report of No-Injury Record form. When completed, the form provides specific information the National Safety Council requires for determining eligibility for the award and for preparing an award plaque. Copies of the NSC form may be obtained from the AMC Field Safety Agency, Charlestown, Indiana, through which award applications are routed before reaching Headquarters, U. S. Army Materiel Command.

Personnel of the U. S. Army Missile Support Command, Redstone Arsenal, Alabama have earned a NSC Award of Honor for operating 3,718,865 man-hours without a disabling injury.

A NSC Award of Merit was earned by personnel of the U. S. Army Electronics Command, Fort Monmouth, N. J. for operating 2,355,876 man-hours without a disabling injury. Congratulations are offered to both installations for these fine efforts in their safety programs.

WELL DID YOU KNOW?

Here are the answers to the questions on pages 33 and 34. All questions were based on information contained in AMCR 385-224, and a reference to the pertinent paragraph follows each answer.

1. 50 feet

   Reference: Paragraph 610, AMCR 385-224.

2. At least one minute.

   Reference: Paragraph 920a, AMCR 385-224.

3. At least 20 feet from warehouses or inert buildings.

   Reference: Paragraph 2405a, AMCR 385-224.

4. TM 743-200

   Reference: Paragraph 2410, AMCR 385-224.

5. DA Label 85

   Reference: 1806, AMCR 385-224

6. One-fourth the length of the ladder.

   Reference: Paragraph 917, AMCR 385-224.

7. The symbol that applies to the most hazardous material in the building should be used.

   Reference: Paragraph 1222a, AMCR 385-224.

8. 100°F. for a period of more than 24 hours.

   Reference: Paragraph 1805a, AMCR 385-224.

9. Safety harness belts of an approved design shall be worn with life lines which must be properly anchored.

   Reference: Paragraph 918c, AMCR 385-224.

10. One minute. It should then be placed in a vertical position, muzzle down, and the explosive cartridge removed.

    Reference: Paragraph 931b(10), AMCR 385-224.

HEADQUARTERS
UNITED STATES ARMY MATERIEL COMMAND
WASHINGTON, D. C. 20315

May 1964

AMC Pamphlet 385-59 is published for the information of all personnel of the U. S. Army Materiel Command.

(AMCAD-S)

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